

CONSTITUTED ON EXPERT COMMITTEE



सत्यमेव जयते

**MID HEALTH
&
FAMILY PLANNING GOVT. OF INDIA**

INTRODUCTORY

Government of India, Ministry of Health and Family Planning (Department of Health) in their letter No. F. 9-2/66-15G dated 22nd November, 1966 constituted an expert Committee as follows :—

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| 1. Asstt. Director General (PHE) (Shri T. Durairaj) | —Convener. |
| 2. Medical Officer of Health Municipal Corporation of Delhi | —Member. |
| 3. Medical Officer of Health, Municipal Corporation of Bangalore | —Member. |
| 4. City Engineer, Municipal Corporation of Ahmedabad | —Member. |

1.2 Terms of Reference

The terms of reference to the Committee were :

- (i) To standardise the types of vehicles and other equipment recommended for the collection and transport of town refuse, for the carriage of nightsoil drums, and for the collection and transport of liquid wastes.
- (ii) To lay down broad specifications for the design of these different types of vehicles, for maximum utility with optimum costs in respect of manufacture, operation and maintenance.
- (iii) To suggest a rational set-up and pattern of staff for public cleansing operations, for different community sizes.
- (iv) To work-out cost estimates for model projects for two or three community sizes or for a given tonnage of refuse to be disposed off.

1.3 The first meeting of the Committee was held on 29-7-1968. All the following members nominated by the Government were present :

1. Shri T. Durairaj,
Deputy Adviser (PHE),
Ministry of Health, Family Planning and
Urban Development.
2. Dr. B.D. Sharma,
Medical Officer of Health,
Municipal Corporation of Delhi.
3. Dr. T.L. Puttaswamy,
Medical Officer of Health,
Municipal Corporation of Bangalore.
4. Shri M.J. Kakkad,
City Engineer,
Municipal Corporation of Ahmedabad.

At this meeting Shri T. Durairaj was elected Chairman of the Committee. Shri C.P. Nakra, Executive Engineer (Auto), Automobile Workshop, Municipal Corporation of Delhi and Shri T.K. Vedaraman, Asstt. Adviser (PHE), Ministry of Health, Family Planning and

Urban Development were co-opted Member and Member-Secretary respectively. Later the Director, Central Public Health Engineering Research Institute, Nagpur or his Nominee and Shri R.J. Acharya, Deputy City Engineer (Workshop) Municipal Corporation of Ahmedabad were also co-opted as Members.

1.4 Information regarding the types of vehicles and the equipment in use for the collection and transport of town refuse (solid as well as liquid wastes) was collected from the Corporation of Delhi, Ahmedabad and Bangalore. Details of vehicles manufactured in India were also collected.

1.5 During the first meeting at Delhi on 29th July 1968, the Committee discussed the note prepared by Shri T. Durairaj on the subject and also inspected the several vehicles in use and also some of the refuse collection and disposal sites in Delhi Municipal Corporation.

1.6 The Committee held its next meeting at Ahmedabad on 29th and 30th August 1968. The Committee saw the several types of vehicles in use and also visited the refuse collection and disposal sites in Ahmedabad and also discussed the technical notes prepared by Shri C.P. Nakra and Shri R.J. Acharya, Members.

1.7 As a result of the studies carried out, examination of the data collected and analysis of all the relevant factors the Committee discussed the details of the problems facing the country in regard to the quick and efficient collection and removal of solid and liquid community wastes and proceeded to set forth its recommendations in this regard.

2. DISCUSSION OF THE PROBLEM

2.1 The problem of collection and disposal of refuse has been associated with man from the beginning of community living upto the present time. It has become more acute with the advancement of civilization. "Public cleansing" which is mainly concerned with the collection and disposal of house and trade refuse and cleansing of streets, plays the same role in the promotion of public health as the provision of adequate supply of drinking water and hygienic disposal of excreta and the 'spent' waters of the community.

2.2 For the past twenty years or so, major cities in the advanced countries have been making strenuous efforts to make this service as hygienic as possible compatible with economy. This has resulted in considerable changes in the method of collection and disposal of refuse. The present emphasis is (1) on building of a sound organisation under a unitary control, (2) suitable changes in the method of storage, collection and transport, to meet the everchanging character of town refuse, and (3) more hygienic and economical methods of disposal. To achieve these objectives this service has to be developed on scientific lines. Mechanisation of the collection and transport are essential.

2.3 The main considerations in the methods employed for operation of public cleansing service are cost, health, sanitation, convenience and aesthetics. An engineering evaluation of all these factors is necessary to determine which method or methods are most satisfactory. This service has also to be treated as a major material handling project, where industrial engineering practices and time and motion study could help in increasing efficiency and reducing cost.

2.4 The public cleansing work is at present attended to by the local bodies and municipalities with the powers vested in them under the Local Bodies Acts, the Municipal Acts and the Corporation Acts. The work at present is mainly entrusted to the Health Officer who is assisted by a number of Sanitary Inspectors. In certain major Corporations this work is under the Engineering Department. In few Corporations the work is partly under the Health and partly under the Engineering Departments. In towns where there is a sewerage system and where there is an engineering organisation to look after the construction of sewers,

the work relating to the sewer maintenance and the maintenance of the fleet of vehicles for refuse disposal is attended to by the engineering department. In most cases all the solid wastes, irrespective of whether they are compostable, combustible, putrescible or not, are all collected together at the street dustbins and then dumped into a number of animal drawn carts or refuse trucks and carried to the final disposal site, where indiscriminate dumping is resorted to.

2.5 In some places composting is resorted to by mixing the refuse with the nightsoil collected by a separate system. Where scientific composting is not done, the refuse collected is allowed to undergo natural composting and utilised after some years by farmers. The nightsoil is trenched and after natural composting, the same is taken and used as manure by farmers. Where there is a sewerage system, the nightsoil from the houses is carried by the sewers to the disposal works. The nightsoil collected from houses, which are not connected to the sewerage system are collected by sweepers and transported in vehicles to selected dumping chutes or pail depots where it is discharged into the sewers. It is not uncommon that in some towns the nightsoil collected by the customary sweepers are dumped indiscriminately along with the street refuse.

2.6 The present practice of collecting all kinds of solid wastes put together and transporting the entire lot to a distant dumping ground, adds to the cost of transportation considerably so much so that the removal of refuse from the habitations is neither satisfactorily done nor is the final method of disposal satisfactory especially if composting or incineration is to be adopted because of the admixture of a significant amount of non-compostable or non-combustible material with the original refuse. So, it is necessary to segregate the different kinds of wastes at source for separate treatment. This will enable the quick collection of the most offensive waste and transport them to a distant disposal site while the other wastes could be disposed of locally without involving heavy transportation cost and without creating health hazards.

The building wastes which are non-combustible and non-compostable are better collected and used for filling up local pits. They need not even be collected daily like garbage and need not be transported over long distances to the final disposal site where the garbage is to be treated. The horticultural refuse such as leaves, cutgrass and miscellaneous shrubs are mostly compostable but inoffensive and could be buried in lawns and gardens without creating any nuisance or health hazards.

2.7 Where land has to be reclaimed from low lying or marshy tracts, the entire garbage and building wastes could, however, be used for sanitary landfills. Where segregation is aimed at, the collection of refuse has to be from individual houses where suitable masonry dustbins or portable plastic buckets with lids can be used. Such refuse collection in the houses is better taken care of by the houseowner as against the practice of dumping refuse into street dustbins, leading to a cleaner street at all times. The conservancy staff can collect the garbage from the houses at regular intervals not less than once a day and dump it into a street collection cart which is to be a covered truck with side sliding doors and provided with tipping arrangements invariably. The vehicles have to be of different sizes such as three-wheelers as for example, scooters and regular heavy duty vehicles. Where the smaller vehicles are used they may be emptied into larger trailers kept located at suitable centres which can be dragged by suitable tractors. The tractors used for agricultural purposes may not be suitable for refuse transportation because of their slow speed. Suitable designs for refuse tractors have to be recommended. The building wastes can be collected in open trucks preferably fitted with tipping arrangements.

2.8 The animal drawn vehicles have to be replaced fairly quickly by mechanised transport for ensuring efficient, hygienic and quick transportation. The use of tarpaulins to cover the open trucks carrying garbage has to be advocated till such time these trucks are converted into closed ones with side sliding doors. The existing trucks in several local bodies are also

also not fitted with tipping arrangements. This arrangement is necessary especially for garbage trucks to enable them speedily unload the wastes and to do a larger number of trips per day. Previously, the tipping equipment for the vehicles had to be imported. Now these are indigenously available involving no foreign exchange. The existing trucks without this equipment have all to be fitted with them.

2.9 Nightsoil Collection and Transportation

2.9.1 The problem of nightsoil collection and transportation can be solved ultimately by having recourse to sewerage system. But it will take several years before all the towns are provided with such a facility. Even where a sewerage system is provided, usually entire town is not covered and even in the sewered portions of the town all the houses are connected to the system at a rapid rate to derive the full benefit of the system. Nightsoil is collected by the old system of conservancy employing human-beings to clean the latrine and to collect and carry the nightsoil manually and dump it into the trucks and transport it to the disposal site. This system has to come to an end sooner than later as there is a general awakening in the masses and the general standard of living is raised. The methods adopted have also to be improved to take into account these social changes. During the transition period where such systems utilising human labour exist, the methods should, however, be improved and better facilities provided for the workmen to discharge their duties. The existing dry type of latrines have to be improved on the lines suggested in the brochure issued by the Central Public Health Engineering Organisation on "Urban Latrines (Conservancy type) and Public Urinals". The nightsoil collected from such latrines can be dumped into drums and transported in wheel-barrows to a local collecting centre from where it is further transferred to bigger vehicles for transportation over longer distances.

2.9.2 Where a sewerage system is provided for a part of the town, the nightsoil collected from the non-sewered area may be dumped into the sewerage system through pail depots or dumping chutes for being transported through the sewers to the disposal site. In the case of these dry latrines the brochure referred to above, gives suitable designs for receptacles for the collection of the nightsoil. The design for wheel-barrows as prepared by the Central Public Health Engineering Research Institute, Nagpur, may be adopted. The nightsoil collected in wheel-barrows is dumped into drums located in several places, which are periodically transported in nightsoil-drum-carts. It is high time that this method of transportation in carts is stopped and replaced by a better sanitary method. Nightsoil brought by the wheel-barrows could be dumped into underground masonry tanks located at some street junctions with some enclosure. Water should be provided at this enclosure for cleaning the wheel-barrows and also for diluting the nightsoil when needed. The contents of the tank can be cleared periodically by means of a vacuum car.

2.9.3 Where houses are located in isolated places and it is not possible to provide any sewerage system at present, the houses may be provided with water closets of the type recommended in the brochure issued by the Central Public Health Engineering Organisation on "Sanitary Water-borne Latrines in Urban Areas". The flushings from the water closets may be collected in a leaching well or an individual septic tank and the effluent dispersed into a local subsoil dispersion system. Where the soil is not suitable for local dispersion of the effluent from the septic tank, the effluent could be collected in a collecting well and the contents periodically cleared by means of a vacuum car or other means. Where feasible the flushings from the closets could be directly drawn into a collecting well which could be cleared periodically by the vacuum cars. The vacuum car has its own advantages for effectively clearing the contents of the collecting well without creating unhygienic conditions near the wells. Where vacuum cars are used for collecting the flushings from the water closets, the other waste waters from the house such as those from kitchens and bath-rooms could be used for local gardening or let into the open street storm water drains to minimise the quantity of liquid wastes to be collected and transported by the vacuum cars. Vacuum cars are already in use in some places like Ahmedabad and they have given satisfactory service.

2.10 Mechanisation of the collection, transport and disposal of solid and liquid wastes of the community.

2.10.1 Mechanical road cleaners are not necessary for our country at present involving as it is much of a foreign exchange and considering the fact that such mechanical sweepers may be needed only in a few big cities and that too for specific highways where there is fast moving traffic.

2.10.2 The mechanisation of the refuse loading and compressing as such, as used in load packers is also not necessary for our country. The refuse in foreign countries consists mostly of light voluminous cartons, packing material etc., which can be compressed for transport while the refuse as is obtained in Indian cities is not of such light variety and is not amenable to much compressing. For the present, manual loading is to be continued generally in preference to mechanical loading.

2.10.3 Mechanisation is essentially required for the quick transport of the putrescible and offensive garbage. The refuse trucks for this purpose have to be suitably built with side sliding doors which could be closed after the dumping of the garbage. To facilitate quick unloading of the wastes at the disposal site, these trucks are to be fitted invariably with tipping equipment which are now available indigenously.

2.10.4 The trucks for the transport of building and other inoffensive wastes may be of the open type but provided with only collapsible end if fitted with tipping equipment or with collapsible sides and end if otherwise, to facilitate quick unloading.

2.10.5 For dealing with heavy dead animals and logs of wood or other material some trucks may be fitted with hoisting equipment in the case of major municipalities and corporations.

2.10.6 The capacity of the collection vehicles is linked up with the width of the streets and lanes in the collection routes. Smaller capacity vehicles should be used to collect refuse from the congested part of the city and the refuse transferred to the larger capacity vehicles at the earliest possible time for being hauled over long distances.

2.10.7 Petrol and diesel driven vehicles are to be preferred to animal drawn vehicles which are to be systematically replaced. Animal drawn vehicles were preferred previously on economical grounds to cover short distances and for negotiating sharp bends and narrow lanes. Now that we have scooters in the market, a small capacity refuse collection vehicle could be manufactured and used to replace the old type of animal drawn vehicle. Such type of three wheeler Lambretta Scooter with refuse body built on it is in use at Ahmedabad Municipal Corporation and is used for the old city area and small lanes. Such small scooter type vehicles can be used in hilly terrains also with ease and efficiency.

2.10.8 In many Corporations and Municipalities they have a mixed fleet of both diesel and petrol vehicles. It is not desirable to have many makes for the following reasons :

- i) Spare parts of all odd makes have to be kept in stock and for want of them, the particular type of vehicle will not be road worthy.
- ii) Specialised mechanics are to be maintained for different makes.
- iii) Spare tools for all makes have to be kept.

It is therefore necessary that the local body maintains a fleet of vehicles with a few makes as possible. It is also desirable to set right the existing position by pursuing action with this objective.

2.10.9 The following vehicles available in Indian market are to be used for building up suitable refuse trucks :

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| a) T.M.B. | 7 ton capacity |
| b) Leyland Comet | —Do.— |
| c) Dodge | 5 ton capacity |
| d) Bedford | —Do— |
| e) Lambretta or Vespa Scooter | 1/2 ton capacity |

2.10.10 Tipping gears which were previously imported are now manufactured in India, by M/s Usha Telehoist Ltd. and M/s Hyderabad Allwyn Metal Works Ltd. The refuse trucks fitted with the tipping gears can be constructed with a closed body with sliding doors. The refuse can be conveyed fairly fast without spilling enroute and can be unloaded quickly without much manual labour. Extra cost involved in fitting the tipping devices is compensated by employing few labourers on vehicles equipped. This enables the trucks to make more trips per day with reduced labour.

2.10.11 The refuse truck bodies have to be fabricated as per Motor Vehicles Act and Rules framed under the Act. Standardisation of these bodies taking into account the following general principles is desirable.

- a) The vehicle should be fitted with a tipping arrangement so that the need for persons getting into the vehicle for unloading is avoided.
- b) The loading height should be kept as low as possible for a sweeper to dump the refuse without much undue strain.
- c) The body for garbage trucks should have a covered top with side double sliding shutters to keep the refuse covered while being transported.
- d) The body for the truck to carry waste building materials need not be covered but the sides should be made collapsible to aid unloading. Such trucks shall also be provided with hooks on the sides to enable a Tarpaulin being used to cover the wastes while being transported.
- e) The rear doors should be capable of being properly locked without getting opened during transit.
- f) Enough seating space should be provided for the crew of the truck while in motion.
- g) The body should be made preferably of corrosion resisting Aluminium Alloy sheet for getting a smooth and easy-to-clean surface, to avoid costly painting and to reduce the dead weight. Where not possible the body shall be made of mild steel sheets 10 BS Gauge thick and painted with two coats of anti-corrosive paint inside and outside.

2.10.12 Where the flow of refuse is more or less continuous and the collection and transportation has to be done fairly quickly such as in market places, or where refuse is collected at a central place using small capacity scooter vehicles or manually worked wheel barrows, it is desirable to dump the refuse directly into a trailer truck kept beside a loading platform. The design and capacity of these trailers can be same as the refuse trucks mentioned above except that a separate tractor is used to haul them. These trailers can be hauled by suitable tractors. One tractor may be provided to deal with 5 to 7 trailers according to the distances involved. The trailers are also to be fitted with tipping gears to save time in unloading. The Agriculture type of tractors are being used in congested cities in view of their manoeuvrability. But the wear and tear is much as they are primarily designed for high torque and slow speed. They also have mud-grip type of tyres for use in fields. But when used on metalled roads

the wear and tear is increased. The efficiency of brakes on high speed is low and skidding is possible. The driver is not protected from sun and rain. The agriculture tractors should not therefore be used to haul the trailers over long distances. As soon as possible the contents are to be transferred to large capacity vehicles or the trailer hauled by jeeps or any other vehicle with suitable hitching arrangement.

2.10.13 *Voltas Horses* : These are special type of refuse transport vehicles in which hydraulically operated loading and unloading system is fitted on to Bedford vehicles. For this, there are special types of covered skip boxes of capacity 2 to 2.5 tonnes. These boxes are kept at approved dust-bin places and are manually loaded. Thereafter the loaded skip boxes are lifted by the said vehicles and carried to the dumping site where dumping is done by hydraulic operation. This is in use at Ahmedabad Municipal Corporation.

2.10.14 *Scammel Horses* : Scammel horse is a triwheeler-tractor which has all the advantages of a tractor without its short-comings but unfortunately it is not manufactured in India.

Few Municipal Corporations such as Delhi, Bhopal and Bombay have such units in operation, but as there is no fresh import licence and the existing units have outlived their utility and as the imported spare parts are also not available, they are being steadily removed from service. It will be desirable if these could be manufactured in India.

2.11 Standardisation of Refuse Trucks, Vacuum Cars and other equipment

After taking into account the existing practices in the major corporations of Delhi, Ahmedabad and Bangalore, the Committee considers that the following vehicles and equipment for the collection and transport of solid and liquid community wastes may be standardised :—

- i) Refuse Truck—Open and Fixed Type—7 tonne capacity built on TMB or Leyland Comet chassis.
- ii) Refuse Truck—Open and Fixed Type—5 tonnes capacity built on Dodge or Bedford chassis.
- iii) Refuse Truck—Closed and Fixed Type—1/2 tonne capacity built on Lambretta or Vespa Scooter chassis.
- iv) Refuse Truck—Closed and Tilting Type fitted with tipping equipment—7 tonnes capacity built on TMB or Leyland Comet chassis.
- v) Refuse Truck—Closed and Tilting type fitted with tipping equipment—5 tonnes capacity built on Dodge or Bedford chassis.
- vi) Vacuum Car—1000 gallon (4500 litres) capacity tank fitted with an exhaustor driven by a prime mover or power take off unit on a heavy duty diesel truck chassis.
- vii) Wheel-barrows—
 - a) Open type for refuse.
 - b) Closed type—Capacity 5 gallons.
 - c) Closed type—Capacity 17 gallons.
 - d) Closed type—Capacity 40 gallons.

Drawings and specification for these are given in Annexures 2 to 13.

2.12 It is desirable to have these designs standardised by the Indian Standards Institution after due consultation with the representatives of the manufacturers of such equipment. They may also consider building of the body with aluminium sheets.

2.13 The Committee feels that it is desirable to conduct research on the following problems by the Central Public Health Engineering Research Institute, Nagpur in consultation with the Central Mechanical Engineering Research Institute, Durgapur wherever necessary.

- a) Study of the indigenous tipping equipment with a view to improvements (for fitting to refuse trucks).
- b) Study of the manoeuvrability of the several designs recommended in the report under various working conditions.
- c) Study of the performance of the indigenous prime movers for running the refuse trucks with special reference to frequent intermittent working.
- d) To evolve suitable designs for tractors for refuse trailers, and
- e) To evolve suitable designs for nightsoil digesters.

2.14 The garbage collected at the disposal site and the nightsoil conveyed by the vacuum cars can be composted by mixing them in suitable proportions. In cases where it is considered desirable to have only the garbage composted and the nightsoil dealt with separately by ordinary trenching or by digestion in suitable nightsoil digestion tanks, these may be done. The Central Public Health Engineering Research Institute who are conducting research on the digestion of nightsoil may be requested to evolve suitable designs for the digesters.

2.15 The Committee feels that the Central Public Health Engineering Organisation, Ministry of Health, Family Planning, Works, Housing and Urban Development, should prepare suitable type designs for the following civil engineering works for guidance to the local bodies :

- a) Minor Collection Centre for the collection of refuse brought by wheel barrows, scooter vans, etc. and where the 5 or 7 trucks are loaded.
- b) Underground tanks for the collection of nightsoil brought by wheel barrows and from where the nightsoil will be transferred to vacuum cars, with the ancillary structures such as the enclosure, shed, office, water supply arrangements etc.
- c) A Central depot for housing, say 20 vehicles, with ancillary structures such as workshop, office building and store.

3. RECOMMENDATIONS

Having considered the problems and the existing practices in regard to collection and transportation of solid and liquid wastes, the committee makes the following recommendations :—

3.1 Public cleansing plays the same role in the promotion of public health as the provision of safe drinking water and hygienic disposal of human excreta and spent waters of the community. This service has to be under the unitary control of a qualified Public Health Engineer, assisted by at least one qualified Automobile Engineer in every major local body.

3.2 In the case of local bodies having a population of over 10 lakhs, the entire work of collection, transportation and disposal of all wastes, solid and liquid, be entrusted to the care of a qualified Public Health Engineer styled 'Director of Public Cleansing', who will have the rank of the Head of a Department in the local body. He shall be assisted by a qualified Automobile Engineer of the rank of an Executive Engineer.

3.3 In the case of local bodies having a population below 10 lakhs, but over 5 lakhs, the work will be in charge of a person generally as detailed in para 3.2 above except that the Automobile Engineer may be of the rank of an Assistant Engineer.

3.4 In the case of local bodies having a population below 5 lakhs but above one lakh, the public cleansing work should be under a separate officer called the Chief Sanitarian under the Municipal Engineer. He may be assisted by a Supervisor (Mechanical). But during the transition period, which should not exceed five years, this work may be continued to be under the Health Department wherever it is so.

3.5 In the case of local bodies having a population below one lakh, the Engineer or the Engineering Officer of the local body will be incharge of the work ultimately, but during the transition period which is not to exceed five years, the work may continue to be under the Health Officer.

3.6 Suitable collection sites shall be fixed by the local body in consultation with its Health and Engineering Officers for the following purposes.

i) Places called Minor Collection Centres for the collection of the refuse brought by the wheel-barrows and scooter vans and tractor-trailers from the area and wherefrom the refuse will be transferred to 5 or 7 tonne refuse trucks.

ii) In the case of cities with population above 5 lakhs, places outside the city limits called the Major Collection Centres, where the refuse brought by the smaller units from the minor collection centres will be transferred again to the large capacity trucks for being transported to the final distant dumping sites.

iii) Places for the construction of suitable underground tanks for the collection of night-soil brought by wheel-barrows (closed type) from the areas served by dry latrines and wherefrom the nightsoil will be transferred to vacuum cars and taken to the final disposal site.

iv) Places for the final dumping and disposal of refuse and nightsoil.

3.7. The wheel-barrows (closed type) as designed by the Central Public Health Engineering Research Institute for nightsoil and the wheel-barrows (open type) as per the design in this report which is in use at Ahmedabad Municipal Corporation are recommended for use by the scavengers and sweepers for collecting the nightsoil and refuse from streets or houses.

3.8. Small capacity trailers of 2 to 3 tonnes capacity may also be used for direct collection of refuse from market places etc. and for being hauled to the intermediate collection sites.

3.9. The Agriculture Tractors may be used in hauling the trailers upto the intermediate collection sites only if alternative mode of conveyance is not available.

3.10. All the refuse trucks of capacity of 5 tonnes and above as well as the trailers of 3 tonne capacity are to be fitted with tipping equipment to facilitate quick unloading.

3.11. The manual loading at the intermediate and the final collection sites is to be avoided as far as possible by dumping the refuse straight into the collection bins which can feed by gravity the larger truck placed below such bins.

3.12. The following norms may be adopted for fixing workload, staff and equipment for public cleansing work.

3.12.1. The refuse to be dealt with may be calculated at per capita rate of contribution of one pound (half a kilogram) per day from a population anticipated three years hence.

3.12.2. The quantity of liquid wastes to be transported in vacuum cars may be calculated on the basis of one gallon per capita (or 5 litres per capita) from the population anticipated three years hence and which contributes to the liquid wastes.

3·12·3. In the congested areas one road sweeper is recommended. for over 25,000 sq. ft. (2500 sq. metres) or part of area to be cleaned.

3·12·4. In ordinary areas one sweeper is recommended for every 50,000 sq. ft. (5000 sq. metres) or part thereof.

3·12·5. In scarcely populated areas one sweeper is recommended for every one lakh sq. ft. (10,000 sq. metres) of area or for every 500 population to be served whichever is higher.

3·12·6. One drain-cleaner is recommended for every 3000 running feet (1000 metres) of drains for sizes upto 24" (60 cms.) dia.

3·12·7. One drain-cleaner is recommended for every 1000 running feet (300 metres) of drain for sizes greater than 24" (60 cms.) dia.

3·12·8. One care-taker is recommended for every public latrine of 12 dry type seats or 24 flush type seats.

3·12·9. One care-taker is recommended for every refuse transfer station.

3·12·10. Four sweepers are recommended for every refuse truck of capacity 5 to 7 tonnes and one mazdoor for every vacuum car.

3·12·11. One driver is recommended for each refuse truck of any capacity or for a Vacuum car for the actual number of vehicles needed for the anticipated wastes from the towns.

3·12·12. The extra for leave reserve for the staff may be provided at 30% .

3·12·13. One Assistant Sanitarian is recommended for every 40 sweepers or scavengers or drain cleaners.

3·12·14. The work of the Assistant Sanitarian will be supervised by two Sanitariums, one dealing with the solid wastes and the other with the liquid wastes. The Supervisor (Mech.) will be incharge of all the vehicles and the Central Workshop and Depot. He will be assisted by a foreman in the Workshop and sufficient number of mechanics depending on the number of vehicles to be dealt with.

3·13. At each local depot where the underground tank is constructed for nightsoil, there shall be the following also:

(i) An enclosure on top of the tank for dumping the nightsoil into the tank.

(ii) A shed for the storing of nightsoil wheel barrows working in the locality (say 10 numbers).

(iii) An office room and store.

(iv) A tubewell with pumping set with an overhead tank for supplying water for cleaning the nightsoil buckets and for adding water to the tank where needed.

3·14. The capacity of the local underground tanks may be 1,000 gallons each and they be cleared once in two days. Each will be able to cater for a population not exceeding 2,000. The capacity of the household collecting wells when the dry latrine is converted into water closet may be for 7 days storage and the cleaning done once a week.

3·15. The Committee recommends the standardisation of the following vehicles:

(i) Refuse Truck—Open and fixed type—7 tonne capacity built on PMB or Leyland Comet Chassis.

(ii) Refuse Truck—Open and fixed type—5 tonne capacity built on Dodge or Bedford chassis.

- (iii) Refuse Truck—closed and fixed type—1/2 tonne capacity built on Lambretta or Vespa Scooter chassis.
- (iv) Refuse Truck—Closed and tilting type fitted with tipping equipment—7 tonne capacity built on T. M. B. or Leyland Comet Chassis.
- (v) Refuse Truck—Closed and tilting type fitted with tipping equipment—5 tonne capacity built on Dodge or Bedford chassis.
- (vi) Vacuum Car—1000 gallon capacity fitted with an exhaustor driven by a prime mover or power take off unit on a heavy duty diesel truck chassis.
- (vii) Wheel-barrows,
 - (a) Open type for refuse.
 - (b) Closed type—capacity 5 gallons.
 - (c) Closed type—capacity 17 gallons.
 - (d) Closed type—capacity 40 gallons.

3-16. The designs and specifications as suggested in Annexures may be followed till such time these designs are standardised by the Indian Standards Institution in consultation with the equipment manufacturers.

3-17. The Committee also recommends conduct of research by the Central Public Health Engineering Research Institute, Nagpur on the specific problems mentioned in para 2-13 in consultation with the Central Mechanical Engineering Research Institute, Durgapur, wherever necessary.

3-18. The garbage collected at the disposal site and the nightsoil conveyed by vacuum cars can be composted in suitable proportions. Where garbage alone is composted the nightsoil may be trenched or digested in suitable nightsoil digesters. The uncompostable material may be disposed of by sanitary landfills for reclamation of low-lying or marshy areas.

3-19. The staff pattern for the public cleansing operations has been discussed in broad lines already and based on this a typical public cleansing project for a town of 2 lakhs population has been worked out and given in Annexure 1.

As the nature and details of the road surfaces and drains will vary considerably from town to town the Committee feels that the purpose will be served if the lines on which such a project is to be worked out is given for a typical town. In any town to start with, all the latrines will be of the dry type which have to be converted into water closets in a phased manner. The typical project worked out assumes that all the latrines are of the dry type. With the progressive change-over of the dry latrines to water closets, the night-soil wheelbarrows will also get reduced in number progressively. The underground collecting tanks provided in the beginning will not be needed when the conversion is completed as the vacuum cars will collect the nightsoil from the collecting wells attached to the houses.

Sd/- T. DURAIRAJ	Chairman
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Sd/- Dr. T. L. PUTTASWAMY	Member
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Sd/- PROF. S. J. ARCEIVALA	Member
Sd/- C. P. NAKRA	Member
Sd/- R. J. ACHARYA	Member
Sd/- T.K. VEDARAMAN	Member-Secretary

ANNEXURE 1

Details for a Sanitation Project for a town of population of two lakhs to deal with garbage and nightsoil only.

1. Quantity of Wastes

The total refuse including garbage, sweepings, ash and horticultural refuse contributed at one pound per capita per day is equal to 2,00,000 lbs. or 90 tonnes per day.

The total quantity of liquid wastes for the ultimate conditions on the basis of one gallon per capita per day is equal to 2,00,000 gallons. In the beginning when there are only dry latrines to be dealt with, the per capita contribution may be assumed at 1/4 gallon per day. The total quantity is equal to 20000.

$$\frac{20000}{4} = 50,000 \text{ gallons.}$$

The quantity of building wastes and the quantity of sullage from house is not considered for this project as they are not of as much public health importance as garbage and nightsoil and could be tackled separately as outlined in the report.

2. Collection of Wastes :

(a) *Garbage* : The garbage etc. from house is presumed to be dumped into masonry dust-bins located at several central places, by the household servants or in scooter vans when they come at specified hours. The road sweepings are also to be conveyed to the central place by means of the open type wheel-barrows.

The garbage from houses located in narrow lanes etc. are to be collected by scooter vans and dumped at the local collection centres. The refuse from the local collection centre is to be transferred to the 5 or 7 tonne trucks of the closed and tipping type and conveyed direct to the disposal site.

(b) *Nightsoil*—The nightsoil from the several dry latrines, household as well as public, is to be collected by scavengers in closed buckets mounted on wheel-barrows and discharged into the several local underground tanks. The underground tanks may be provided with an enclosure on top which will act as dumping chutes for discharging the nightsoil. An overhead tank with a tube-well and pump set may be provided for water supply for cleaning the buckets of the wheel-barrows and for adding water to the nightsoil, if necessary for giving it more fluidity. These tanks may be cleared once in two days by vacuum cars. The capacity of the tanks may be 1,000 gallons, which will be the same as the capacity of the vacuum car. These tanks may be located in a number of convenient central locations for collecting the nightsoil. Adjoining the underground tank a shed for the storing of the wheel-barrows say 8 or 10 numbers may be constructed. An office room and a store room may also be provided for the Assistant Sanitarian to take attendance of the staff members etc. The vacuum car collecting the contents from these tanks will discharge them at the disposal site for making compost with the garbage also collected at the same place.

3. Details of Vehicles, Equipment and Staff:

The Municipal Engineer of the Local Body will have the overall control of the public cleansing work. He will be assisted by a full-time Public Cleansing Officer called the Chief Sanitarian, who will be further assisted by one Sanitarian for dealing with solid wastes and the staff employed thereon, another Sanitarian for liquid wastes and for the staff employed thereon

and one Supervisor (Mechanical) for having control over all the transport vehicles and its staff. The subordinate staff will be as per the recommendations in the report. The number of sweepers will be based on the area to be cleaned and the length and size of drains to be cleaned. On a rough basis, one sweeper for every 500 population has been provided including leave reserve. Likewise one scavenger for every 500 population including leave reserve has been provided. One driver and 4 sweepers are allowed for each transport vehicle excluding the vehicle reserve but including a leave reserve of 30% for the staff. For each vacuum car one driver and one scavenger has been provided excluding vehicle reserve but including a leave reserve of 30% for the staff. The work of the scavengers, sweepers and drain cleaners will be supervised by Assistant Sanitarians on the basis of one Assistant Sanitarian for every 40 sweepers etc. All the vehicles viz. Refuse trucks, Vacuum cars and Scooter vans will be kept during the night at a central depot which will have a maintenance workshop attached to it. The Supervisor (Mech.) will have his office at the Central Depot along with the Workshop Foreman and his staff. The two Sanitarians and the Chief Sanitarian will work in the Municipal Office along with the Municipal Engineer.

(i) Total refuse per day = 90 tonnes.

(ii) Number of trips for a 7 tonne vehicle $90/7 = 13$

(iii) Assuming 3 trips per vehicle per day the number of vehicles needed $13/3 = 4\frac{1}{3}$

(iv) Allowing 20% reserve, number of vehicles $4\frac{1}{3} \times 1.2 = 5$ numbers nearly.

(v) Number of drivers (one per vehicle) excluding vehicle reserve plus 30% leave reserve
 $4\frac{1}{3} \times 1.3 = 5.6$ or 6

(vi) Lorry sweepers (4 per driver) $4 \times 6 = 24$ persons.

The quantity of liquid refuse for the ultimate conditions at one gallon per capita is equal to 2,00,000 gallons assuming that the household collecting wells are cleared one a week and that 1/7th of the town is attended to per day and assuming the capacity of the vacuum car to be 1,000 gallons and assuming six trips per day for a vacuum car the number of cars needed

$$= \frac{200000}{6 \times 1000} = 33 \text{ nearly.}$$

As the conversion of all dry latrines into water closets will take sometime and the night-soil collected from dry latrines have to be transported by wheel-barrows to underground tanks, the quantity per capita may be assumed at 1/4 gallon per day. Total quantity of liquid wastes to start with is $200000 \times 1/4 = 50,000$ gallons. Numbers of trips for a 1000 gallon capacity car = $50000 \div 1000 = 50$.

$$\text{Assuming six trips per day, number of cars needed will be} = \frac{50}{6} = 8\frac{1}{3}$$

$$\text{daily. Including 20\% reserve total number needed} = \frac{50 \times 1.2}{6} = 10.$$

The total capacity of the public collecting tanks based on clearance once in two days and that only 1/2 of the town is dealt with per day = 50000 gallons. Assuming 1000 gallons capacity

$$\text{tanks number of underground tanks} = \frac{50,000}{1000} = 50 \quad \text{Number of vacuum car}$$

drivers @ one per car (excluding 20% reserve + 30% leave reserve) = $8 \times 1.3 = 10$ numbers.
 Vacuum car sweepers at one per car driver = 10

Sweepers @ one for 500 population = $200000 \div 500 = 400$

Scavengers @ one for 500 population = $200,000 \div 500 = 400$

Drain cleaners say 100 = 100

Total 900

At the rate of one Assistant Sanitarian for every 40 persons, number of Assistant Sanitarian needed = $900 \div 40 = 22.5$ or say 25 numbers.

4. Estimated cost for Installation

(a) Buildings and structures

	Rs.
(i) Central Depot for 20 vehicles—L.S.	40,000
(ii) Central Maintenance and Repair Workshop . . . L.S.	23,000
(iii) Office building and Store Room attached to the Workshop L.S.	16,000
(iv) Local Depots each consisting of One 1000 gallon underground tank, one enclosure to house the dumping chute; One shed for storing nightsoil wheel-barrows (about 10 Nos.) An office room and a Store Room, Tube-well with Pumping Set and overhead tank with pipe connection	<div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> <div style="font-size: 3em;">}</div> <div>50 Nos. L.S. 5,51,000</div> </div> </div>
(v) Local masonry dust-bins @one for every 400 population = $200000 \div 400 = 500$ nos. @Rs. 800 L.S.	4,00,000

(b) Equipment

1. Refuse Transport Vehicle 5 nos.	@Rs. 50,000	2,50,000
2. Vacuum Cars . . . 10 nos.	@Rs. 60,000	6,00,000
3. Scooter Vans . . . 5 nos.	@Rs. 9,000	45,000
4. Wheel-barrows (open type) 400 nos.	@Rs. 150	60,000
5. Wheel-barrows (closed type) 400 nos.	@Rs. 300	1,20,000
6. Misc. tools & spares L.S.		26,000

Total 21,30,000

Say 21.5 Lakhs

5. Estimated Cost for Maintenance

(a) Staff

Designation	No.	Scale of pay Rs.	Average pay Rs.	Total cost (Rs.)
1. Municipal Engineer (Part-time)	1	400—950	675	225
2. Public Cleansing Officer (Chief Sanitarian ;	1	250—425	350	350
3. Sanitarians	2	150—300	225	450
4. Supervisor (Mech.)	1	150—300	225	225
5. Assistant Sanitarians	25	110—180	145	3,625
6. Lorry Drivers	6	110—155	135	810
7. Vacuum Car drivers	10	110—155	135	1,350
8. Sweepers	400	70—80	78	31,200
9. Scavangers	400	70—80	78	31,200
10. Transport Mazdoors	28	70—85	78	2,184
11. Drain Cleaners	100	70—85	78	7,800
12. Workshop Foreman	1	150—300	225	225
13. Store-Keeper	1	150—300	225	225
14. Storeman	1	70—85	78	78
15. Mechanics	4	110—155	135	540
16. Peons	4	80—85	78	312
17. Add. for D.A. (for all Staff)			L.S.	72,000
TOTAL				1,52,799
Annual cost of establishment				18,33,588

(b) Maintenance of buildings and structures	L.S.	25,000
(c) Maintenance of Workshops and Vehicle Depot	L.S.	20,000
(d) Spare parts etc.	L.S.	20,000
(e) Misc. Stores, Electricity and water charges etc.	L.S.	10,000

TOTAL Rs. 19,08,588
or say 19.00
lakhs.

10.75 and Not 10.74

Cost of installation per capita = $21.5 \div 2 = \text{Rs. } 10.75$

Cost of annual maintenance per capita = $19.00 \div 2 = \text{Rs. } 9.50$

ANNEXURE 2

SPECIFICATIONS

SPECIFICATIONS FOR REFUSE TRUCK

(A) SPECIFICATIONS FOR DRIVER CABIN AND WORKMEN'S COMPARTMENT (COMMON FOR ALL TRUCKS)

1. General

The chassis will be supplied with the complete front show and the dash board. The heavy duty diesel truck chassis shall be of approved design fitted with dual rear 12 ply heavy duty tyres with complete spare wheel, battery, tool-kit, power take off provisions, etc. The fabrication shall be such that renewals can be made without any disturbance to the general structure. The drivers' cabin and the workmen's compartment shall be constructed of Mild Steel sheets of 18 B. S. G. (Stamped). The drivers' cabin shall be a full type and framed integral with the workmen's compartment. The structure shall be fabricated with proper 16 gauge M.S. pressed sections and all structural members shall be adequately fixed with suitable brackets and gussets securely rivetted with alloy rivets or bolted together with self-locking fastenings to ensure maximum tightness or welded. The cabins shall be built in to conform to the Motor Vehicle Rules of State/Government/Transport Authority. Handles outside the cab shall be provided for the Driver and co-driver as well as for workmen to enter in and to get out. Monogram shall be painted outward on both the doors. All timber used for work shall be of seasoned and approved quality.

2. Roof

Roof shall be of standard type and design and supported strongly. It shall be shaped properly to conform to the aesthetic appearance of the model. The roof joints shall be interlocked and so made that these are leak proof. Two coats of an approved paint be applied before fixing the roof inner canvas.

3. Steps

The steps for the driver's as well as the workmen's compartment shall be designed for rough wear and tear, and shall be made of one piece properly braced and covered with aluminium chequered plates wearing strips.

4. Flooring

The flooring for the driver's cabin and the workmen's compartment shall be made from Aluminium P. B. P. alloy 3 mm. thick aluminium floor plates. No alteration shall be done to the engine cover. However if any fittings are made, careful attention shall be paid to the fact that the opening arrangements of the engine cover is not disturbed. It shall be further seen that hand-brake and other gearing system is allowed free movements. All sheets shall be pressed and fixed to the channel section in such a manner that the joint is completely dust proof.

5. Doors

The doors shall be provided on both sides of the Driver's cabin. These two doors shall be hung upon stout steel hinges and shall be of mild steel, provided with a stop sector and suitable locking arrangements. The doors in the driver's cabin shall be provided with a quarter glass fixed in the front to divert flow of air into the cabin and the same should be capable of being adjusted and locked in a position flush with the door. The doors shall be provided with panels of 3/16 (4 mm.) thick toughened glass which can be moved up and down by a mechanical regulator. For workmen's Compartment the door should open on

the left side. On the right side, i. e., the driver's side there should only be an emergency door with proper locking arrangements. The glass shall be as above.

6. Seats

The driver and co-driver's seat frame shall be of $\frac{3}{4}$ " dia. m. s. pipes duly framed with sufficient cross members to strengthen it with a movable seat on it which can be moved forward or backward by a screw type handle. The driver's seat shall be of foam cushion and of thickness not less than 4" (10 cm) and the seat back shall be of 2" (5 cm) thick foam cushion. Both will be covered with PVC cloth of approved quality. The seat shall be capable of being adjusted forward or backward with a play of 3 (7.5 cms.).

The co-driver's seat and the seat for workmen in the workmen's compartment shall be of 4" (10 cm) thick coir jute.

The seat and the back shall be covered with PVC cloth of approved quality.

7. Lighting

Rear number plate light, auxiliary rear light, stop light, directional indicator lights, workmen's compartment light and the Driver's cabin light shall be provided over and above the front head and side lights. Lighting controls shall be placed at convenient position near the driver with individual fuses. Lights and reflector shall be of approved make. All light wiring shall be connected in positions to be run in approved rigid plastic conduits or troughing and so arranged that they can be readily inspected and renewed without unduly disturbing interior finish of the vehicle. All cable shall be oil resisting, flame proof braided and lacquered.

One hand lamp (break down light) with 7 metres wire should be provided with proper hook and fitted to the dash board in the driver's cabin so that it can be easily taken out when necessary.

8. Painting

The interior and under carriage of the driver's cabin and workmen's compartment shall be painted with two coats of anti-corrosive paint while the exterior shall be painted with synthetic enamel paint of approved shade and quality.

9. Accessories

- (i) *Driver Signals*—A hand operated direction indicator made of 20 gauge M. S. Sheet with embossed arrow, the entire area being painted white and the arrow in red, shall be fixed at convenient place so that the driver can operate it with ease while driving. A suitable light signal shall also be fixed if not provided with the chassis.
- (ii) *Tool Box*—As the vehicles will be operated by a Central Agency *there is no need for a tool-box* as the break-downs can be attended by the staff of workshop.
- (iii) *Rubber-mattings*—Rubber mat of good quality shall be provided in the driver's cabin as well as workmen's compartment.
- (iv) *Glasses*—In between the driver's cab and the workmen's compartment a sliding glass mounted on a rubber channel fixed in side a M. S. Channel and with proper locking arrangements with suitable handle shall be provided. At the back of the workmen's compartment a fixed glass with M. S. bars fixed on the outside should also be provided so that the driver can see through it. One rear view Mirror of 6" × 4" (150 mm. × 100 mm.) size of adjustable type shall be provided and positioned at appropriate place. The mirror should be preferably of convex type. All glasses used shall be of approved quality.

- (v) *Bulb Horn*—A good quality bulb horn shall be fitted in front under the engine bonnet and shall be operated from inside the driver's cabin.
- (vi) *Battery-Box*—A sturdy battery cradle of adequate size shall be properly fitted near or beneath the co-driver's seat made out of $1\frac{1}{2}" \times 1\frac{1}{2}" \times \frac{1}{4}"$ (35 mm \times 35 mm \times 6 mm) angle iron and 10 B.S.G. (stamped) sheet with flap door in the front and top having suitable locking arrangements.

10. Workmanship

The following conditions with regard to the workmanship shall be observed by the Body builders—

- (i) All castings and metal fabrications must be truly formed,
- (ii) All rivets and bolt holes shall be jig drilled (not punched) and filled with well fitting rivets or bolts. The rivets used shall be pop rivets, shall be well and truly formed and neatly finished. Before rivetting or bolting should any rivet or bolt hole not be fair and true with the work in its correct position, the piece shall be replaced by another with the holes, correctly drilled.
- (iii) All joints shall have a coat of approved di-electric paint on both surfaces immediately before rivetting, bolting or screwing up.
- (iv) All removable wood casing, etc., shall be secured by means of brass screws. All steel screws, bolts, nuts, rivets, etc., shall be made rust proof by a recognised process.
- (v) All paint and varnish work shall be done in a suitable paint shop which shall be well ventilated for an even temperature and free from all dirt and dust. Each coat must be allowed to dry and harden before the next is applied and the final coat should be allowed to harden and dry before the body, *i. e.* vehicle is removed from the paint shop.
- (vi) When the vehicle is made complete all openings windows, doors, ventilators, roof, etc., shall be subjected to a water test.
- (vii) All fittings and furnishings shall be capable of being operated with minimum inconvenience.

(B) SPECIFICATIONS FOR REFUSE TRUCK-BODY

General

The dimensions of the refuse truck body varies according to the wheel-base and the model of the vehicle, *viz.*, full forward, semi-forward, normal control, etc. However, body dimension should be kept as per the requirements conforming to the Motor Vehicle Rules of the State Government/Transport Authority. Generally the breadth is 7'—6" (225 cms.) and the depth is 2'—0" (60 cms) having proper fastening hooks or sliding doors arrangements. The length depends upon the type of vehicle, and its model. The body should be properly painted with two coats of synthetic enamel paint after applying proper primer coating. On the collapsible or fixed side doors monograms should be got painted on both the sides.

Body—The body shall be built of 10 B. S. gauge (stamped) Mild Steel Sheets, and fabricated with proper sections of proper gauge. The flooring shall be of 10 B. S. G. M. S. Sheet.

The refuse truck body shall be supported by two longitudinal M. S. Channels $6" \times 3"$ (15 cm. \times 7.5 cm) of proper thickness having 8 Nos. of cross bearers of M. S. Channel $4" \times 2"$ (10 cm. \times 5 cm) duly welded to form a frame work. The main body frame shall be made of $4" \times 2"$

(10 cm × 5 cm) M. S. Channel of proper thickness. The construction of the sides varies according to the type of operation—

- (i) *Fixed*—which has got downward collapsible sides, as well as rear doors made of $1\frac{1}{2}" \times 1\frac{1}{2}" \times \frac{1}{4}"$ (35 mm × 35 mm × 6 mm) angle iron frame and 10 gauge M. S. Sheets properly braced.
- (ii) *Tilting*—which has got fixed sides and the rear door shall be openable in flap manner with proper fulcrum arrangement at the rear top end of the sides. This rear door shall also be removable. This shall be of $1\frac{1}{2}" \times 1\frac{1}{2}" \times \frac{1}{4}"$ (35 mm × 35 mm × 6 mm) angle iron frame and 10 gauge M. S. Sheet properly braced.

Rear Mud Guards.—The rear mud-guards shall be of 10 B.S.G. sheet and shall be fixed to the body above the rear wheels.

- (a) *Fixed Type*—(Open): In this type of body, the body is completely fitted with the chassis with proper fasteners. The body has got five downward collapsible doors, two on each side and one at the rear.

The frame of the door shall be of $1\frac{1}{2}" \times 1\frac{1}{2}" \times \frac{1}{4}"$ (35 mm × 35 mm × 6 mm) angle iron duly covered by 10 B. S. Gauge M. S. Sheets. The doors shall be suitably hinged to the main body frame. To facilitate the locking of side doors, and rear door, M. S. round hook shall be provided suitably fixed with M. S. Chain. Proper hooks of M. S. Round 9 mm. dia, shall be provided on either side of the side doors and at the rear door. A minimum of six to eight hooks shall be provided on either side of the side doors, depending upon the length of the body and a minimum of four hooks shall be provided on the rear door.

- (b) *Tilting Type*—(i) *Open*—In this type of body the longitudinal channels should hinge at the rear of the body chassis which is cut at an angle to give proper angle of tilting. There shall be side guides on both sides of the main chassis so as to allow proper alignment when in normal use. The rear door shall be of such construction that it can be removed as well as it can flap out having fulcrum action on both the top ends.

(ii) *Covered*—Here the body as stated above is covered with suitable number of double sliding quarter elliptical covers of 18 gauge M. S. Sheets moving in proper recess.

Tipping Gear Kit.—The tipping gears of double barrel system—telescopic in nature shall be supplied to the body builder alongwith the chassis. This should be fitted under the body with the chassis, instead of at the rear of the workmen's compartment above the chassis. This should be observed so as not to reduce the length of the body. The tipping gear kit is to be assembled and fixed as per the manufacturers' instructions.

Painting.—The body shall be painted with two coats of synthetic enamel quality on properly applied primer surface. The under carriage parts and the chassis shall be painted with two coats of anti-corrosive rust proof black paint of approved quality.

ANNEXURE 3

Specifications for vacuum car for collection of liquid wastes (Based on the Vacuum car in use at Ahmedabad Municipal Corporation)

General

The vacuum car comprises mainly of a cylindrical tank of suitable dimensions for the collection of the liquid wastes, mounted on a chassis of suitable make and fitted with necessary fittings with either—

- (i) an independent engine coupled exhaustor unit set, or (ii) power-take-off exhaustor unit.

(1) **Tank**—The tank shall be of cylindrical type having over all dimensions as 9'—6" (285 cm) length 4'—6" (135 cm) diameter, made out of 10 mm. thick mild steel plate with dished ends of the same thickness. There shall be two compartments. One will be the main tank of 8'—6" (255 cms) long of 850 gallons (3,860 litres) capacity for collection of the liquid wastes, provided with suitable openings for various connections, mountings, etc. The other auxiliary tank of nearly 30 cm. length of 500 litre capacity will be for storing clean water. This clean water is used by the exhaustor for water sealing. The separating circular partition shall be of 5 mm. thick M. S. Sheet welded internally on both sides to make the inside leak-proof and the same shall be diagonally reinforced by $1\frac{1}{2}" \times 1\frac{1}{2}" \times \frac{1}{4}"$ (35 mm \times 35 mm \times 6mm) angles properly welded to it. There shall be proper openings for fittings and mountings. The rear end of the main tank is to be provided with a hinged circular door prepared out of 10 mm. M. S. Sheet and made vacuum tight by means of a square rubber ring $1\frac{1}{2}" \times 1\frac{1}{2}"$ (35mm \times 35 mm) cross-section housed in a recess formed by two flat bars $1\frac{1}{2}" \times 1"$ (30mm \times 25mm) continuously welded on the inside of the rear door. The surface against which the rubbering is to rest shall be machined so as to help to maintain the joint vacuum tight. The door is to be closed by providing $1\frac{1}{2}"$ (30 mm) diameter 8 screws properly placed in clamps made from M. S. and equally spaced and hinged along the circumference. There shall be an opening handle properly welded to the door. The bottom portion of the tank shall be provided with proper gussets and brackets prepared out of 10 mm. M. S. Sheets duly welded externally and spaced at nearly 75 cms. having suitable adjustable holds for fixing it to the chassis of the truck.

(2) Exhaustor or the Exhaust Pump Set

The exhaustor shall be of rotary type with ball bearings. It can either be driven by—

- (i) Power take off from the main truck engine through an extension shaft from the gearbox or,
(ii) directly coupled to a diesel engine (prime-mover) of 10 HP discharging exhaust gases through a separate silencer. The exhaustor shall be of 50 mm size suitable to work at 1450 R.P.M. and capable of creating a vacuum equivalent to 65 cms of mercury and discharging air at the rate of 2.7 cu. metres per minute with proper water seal and cooling arrangements.

(3) **Fittings** (i) **Pipe**—The air pipe from the top of the main tank and the water pipe from the bottom of the auxiliary tank are connected to the suction side of the exhaustor on either side and the delivery from the pump is taken to the top of the auxiliary tank.

(ii) **Air Strainer**—There shall be an Air Strainer incorporated in the suction pipe line and it shall be fitted in such a manner that it can be removed easily for periodical inspection and cleaning.

(iii) *Suction Valve & Pipe*—The suction pipe connection on the left side of the vehicle on the tank shall be provided with a heavy duty 75 mm. size lever acting sluice type valve with suitable union to connect the flexible suction pipe. This valve should be located below the centre line of the tank of its periphery and the pipe continuing it should protrude inside upto about 2" (5 cms.) away from the inside of the tank at an angle such that it is just near the top of the tank. This is necessary so as to prevent the sucked liquid being back flown through the suction pipe.

(iv) *Suction House*—It shall be of reinforced type complete with round thread gun metal/cast iron coupling and hose-clips.

(v) *Discharge Valve*—The discharge valve of heavy duty 4"(10 cms) size lever acting sluice type shall be provided near the rear bottom of the tank.

(vi) *Gauge*—A connection shall be provided near the rear top of the centre of the main tank for fixing the combined vacuum and pressure gauge of 10 cm. dial and 0 to 76 cm. range.

(vii) A connection for extraction of air from the main tank shall be provided on the rear top of the main tank.

(viii) A water inlet connection to the auxiliary tank shall be provided at the top for water coming out from the exhaustor.

(ix) An outlet shall be provided to the auxiliary tank with 35 mm drain cock at the bottom.

(x) An air vent shall be provided at the top of the auxiliary tank.

(xi) An opening for filling clean water to the auxiliary tank shall be provided at the centre of the top with a 10 cms. hinged cap.

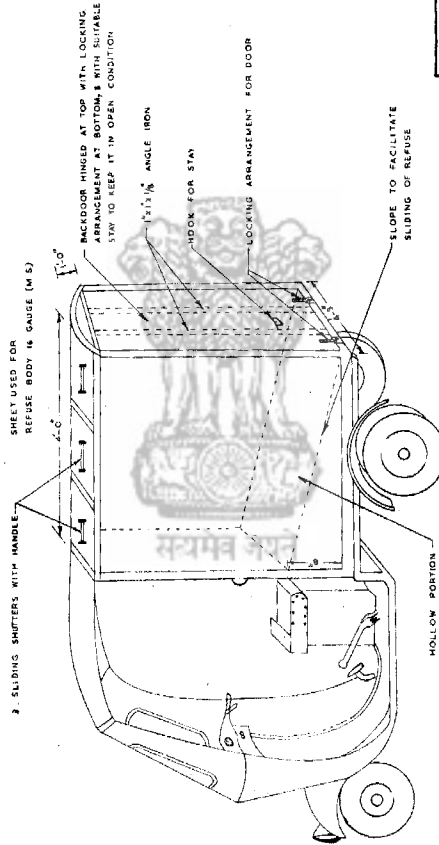
(xii) *Relief Valve*—This shall be fitted on the top of the main tank.

(xiii) *Overflow Valve*—An overflow valve which automatically cuts off the air outlet when the tank is full, shall be provided on the top of the main tank.

(xiv) Two wooden rest boards of full length of the vehicle behind cabins shall be provided on both sides of the tank, with proper locking device for putting the hose pipes. The wooden board shall be of 35 mm thick \times 30 cms good quality wood.

(xv) Proper railing on both sides of the tank shall be provided for easy grip while standing on wooden platforms for inspection or repairwork of the tank, and its accessories.

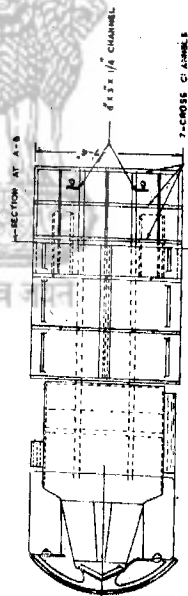
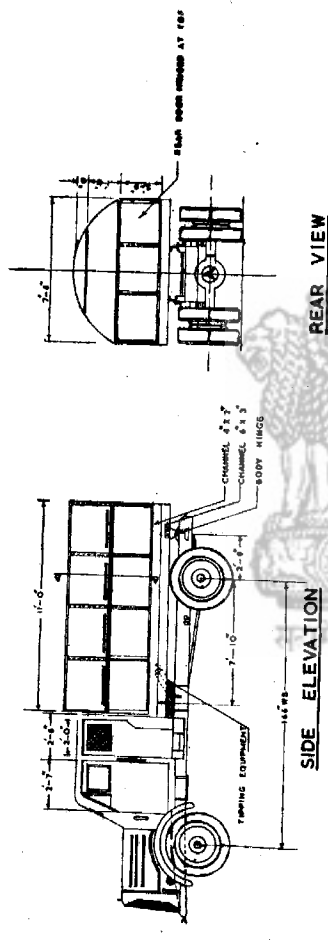
(xvi) *Painting*—The outside of the tank shall be painted with suitable synthetic enamel paint with two coats after following painting procedure. The inside of the tank shall be painted with double coat of anti-corrosive paint of suitable quality. The chassis and under carriage parts shall be painted with two coats of anticorrosive black paint of appropriate quality.



(SKETCH NOT TO SCALE)

REFUSE COLLECTING VAN HALF-TON CAPACITY (SCOOTER TYPE)

ANNEXURE TO COMMITTEE REPORT ON
MECHANISATION OF REFUSE TRANSPORT



P L A N

DRAWING NOT TO SCALE

REFUSE TRUCK BODY
BUILT ON T.M.B. CHASSIS
CAPACITY 7 TONS

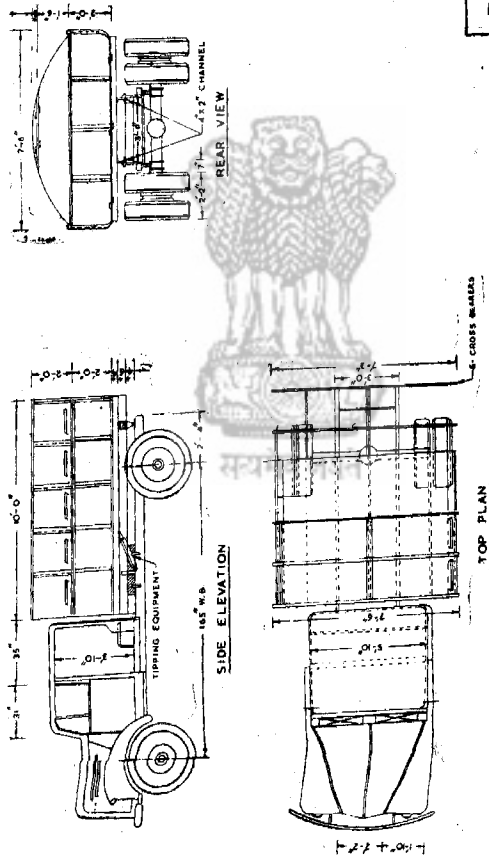
ANNEXURE TO COMMITTEE REPORT ON
MECHANISATION OF REFUSE TRANSPORT

CPHEO.DRS.NO.MISC.237

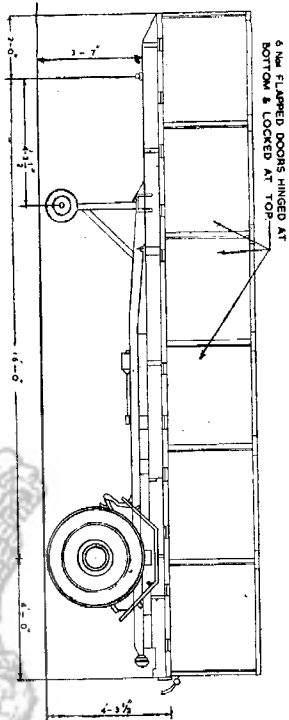
DODGE KEW REFUSE TRUCK
TIPPING TYPE

ANNEXURE TO COMMITTEE REPORT ON MECHANISATION OF REFUSE TRANSPORT

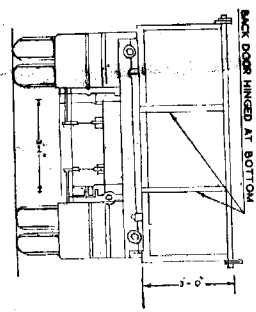
CPHEO DRG. NO. M. 23B.



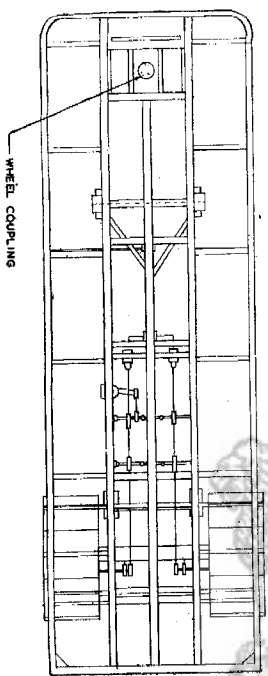
DRAWING NOT TO SCALE



ELEVATION



SIDE ELEVATION



PLAN (WITH BODY REMOVED)

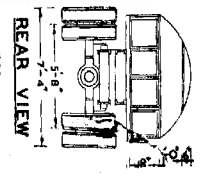
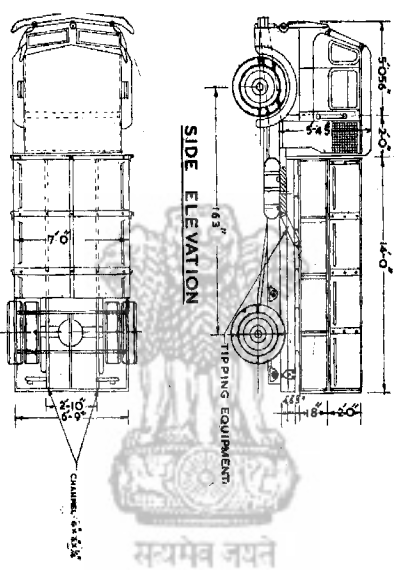
DRAWING NOT TO SCALE

ANNEXURE - 8

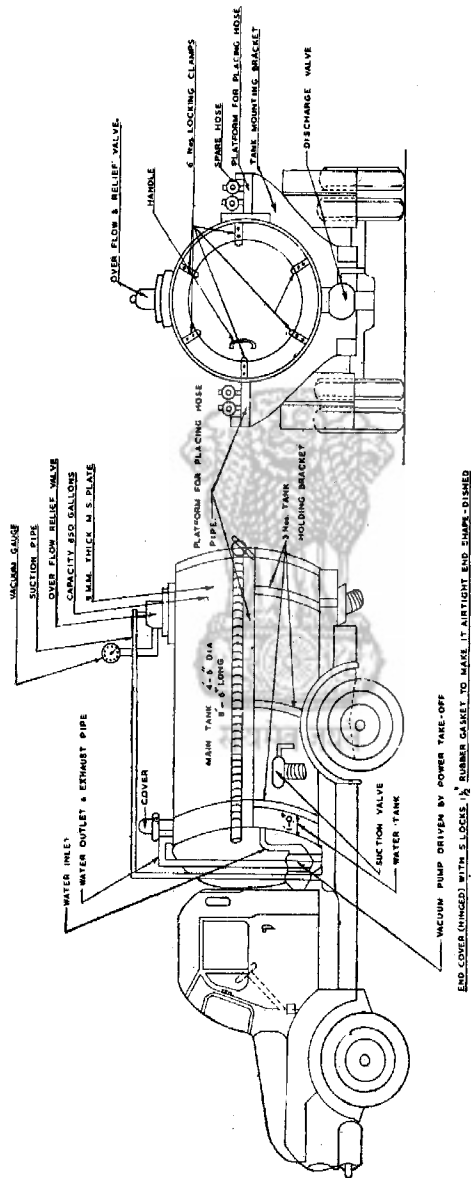
ARTICULATED REFUSE TRAILER
CAPACITY-----12 TONS
ANNEXURE TO COMMITTEE REPORT ON
MECHANISATION OF REFUSE TRANSPORT.

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REFUSE TRUCK BODY
BUILT ON LEYLAND COMET
CHASSIS CAPACITY-7 TONS
ANNEXURE TO COMMITTEE REPORT ON
MECHANISATION OF REFUSE TRANSPORT



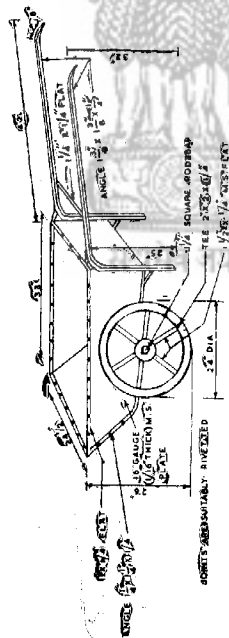
DRAWING NOT TO SCALE

VACUUM CAR

(FOR COLLECTING LIQUID WASTE)

ANNEXURE TO COMMITTEE REPORT ON MECHANISATION OF REFUSE TRANSPORT

NOTE:- DESIGN BASED ON VACUUM CAR USED IN AHMEDABAD MUNICIPAL CORPORATION.



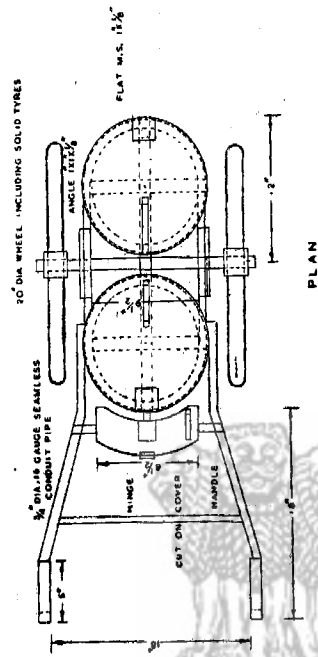
NOTE:- DESIGN BASED ON WHEEL BARROW USED IN VARIOUS AREAS OF THE CORPORATION.

DRAWING NOT TO SCALE

WHEEL - BARROW (OPEN TYPE)

ANNEXURE TO COMMITTEE REPORT
ON MECHANISATION OF REFUSE TRANSPORT.

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NOTE - THIS DESIGN HAS BEEN DEVELOPED BY THE CENTRAL PUBLIC HEALTH ENGINEERING RESEARCH INSTITUTE NAGPUR.

ANNEXURE TO COMMITTEE REPORT ON MECHANISATION OF REFUSE TRANSPORT

CPHEO DRG NO M243



ANNEXURE TO COMMITTEE REPORT ON
MECHANISATION OF REFUSE TRANSPORT

HEALTH ENGINEERING RESEARCH INSTITUTE NAGPUR.

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